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(54) PROCESS FOR THE PRODUCTION OF FOODS

(71) We, COOPERATIEVE VERKOOP- EN PRODUCTIEVERENIGING VAN AARDAPPELMEEL EN DERIVATEN "AVEBE" G.A., a Body Corporate organised under the laws of The Netherlands, of 13 Postweg, Veendam, The Netherlands, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a process of manufacturing foods comprising milk and a starch-type thickening agent e.g. puddings and custard cream. Such foods are sometimes called viscous dairy products.

For many decades custards and puddings have been prepared by the housewife by stirring corn starch, a flavouring agent, e.g. vanilla, sugar, and, if desired, still other substances with a small amount of cold milk till the mixture is a smooth paste and pouring it into the desired amount of boiling milk. The mixture is boiled further for some time. After cooling, the product obtains the desired texture and consistency.

The so-called instant pudding powders were an advance for the housewife. These products consist of a mixture of pregelatinized starch, sugar, aroma, colouring substances and gelling agents. As starting material for the pregelatinized starch potato or tapioca starches are used. The instant products are directly added with stirring, to the desired amount of cold milk. After about half an hour the pudding product obtains the desired consistency and texture.

Although these instant products have facilitated the preparation of puddings considerably, the use of puddings and custards which are completely ready for consumption has assumed large proportions in various countries. These products are delivered to the housewife in bottles or in throw-away packing e.g. of paper or of plastic.

The preparation of puddings and custards in the form of a product ready for use occurs has been carried out batch-wise by heating a mixture of milk, thickening agent, sugar and colouring and flavouring substances for some time at a temperature of from 80 to 100°C. As thickening agent, corn starch is used and, if desired, one or more other auxiliary agents During heating the thickening agent gelatinizes. After heating the dairy product is put in bottles or in throw-away packing at a suitable temperature.

Since the process is discontinuous, the capacity is often limited and the quality of the viscous dairy products may vary because the process is carried out under imperfectly controllable conditions. Furthermore, the product can be kept only for a limited period due to the mild production conditions. Sterilisation of the product in bottles is possible; however, this adversely affects the taste and the structure of the dairy product.

Various engineering works have developed installations wherein the continuous production of viscous dairy produce and simultaneous sterilisation is possible (e.g. in the systems Stork, Alfa Laval and Alpura). In the continuous production of viscous dairy products the powdery components (sugar dextrose, thickening agent, flavouring and colouring substances and, if desired, gelling agents) are added to the milk while stirring at 7—25°C. Then the mass is pumped through one or more heat exchangers bringing the temperature of the mass in about 0.5—2 minutes to 80 to 90°C. Thereupon the mass is brought to a temperature of about 135—150°C by direct steam injection or by indirect heating. During this heating which takes about 3—30 seconds, depending on the system applied, the thickening agent gelatinizes and the mass is simultaneously sterilized. Then the mass flows to an expansion evaporator (in case of heating with direct steam) or to a cooler (in case of indirect heating), whereby the temperature of the mass falls to about 40—70°C. In the expansion evaporator the superfluous condensed water of the direct

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steam heating is sucked off by a vacuum pump connected to the expansion evaporator. Thereupon the mass is put into paper containers or after cooling to 5°C in bottles or in plastic packing. After cool storing for about a day the dairy produce will have obtained the desired consistency.

The continuous process, which is carried out under readily controllable conditions, has, amongst others, the following advantages: the simplicity of the process, the great capacity and the obtaining of a product of constant and sterile quality. Moreover, owing to the very short residence times at higher temperatures the taste of the product is less adversely affected than in the discontinuous process in which case the mass is exposed to higher temperatures during a relatively long period of time.

In the application of a continuous process for the production of viscous dairy products it has, however, been discovered that the use of corn starch, as a thickening agent, which is generally applied as such in the discontinuous process, is not very suitable. This can be explained by the difference existing between a discontinuous and a continuous process for the production of viscous dairy products.

In the discontinuous process the temperature of the mass is slowly raised to as a rule 90°C. During heating the gelatinisation of the corn starch takes place. In the continuous process, however, the temperature of the mass is quickly raised to e.g. 135—150°C. The corn starch granules, however, disintegrate completely at this high temperature, whereby a product is formed having a coherent more or less slimy structure. Consequently, with the use of corn starch for the continuous production of viscous dairy products, products of less good quality are obtained.

From the above it can be seen that a thickening agent for the continuous production of viscous dairy products must meet specific requirements. The gelatinisation behaviour of the thickening agent must be adapted to the short residence times and to the high temperatures applied in the continuous production. At the end of the heat treatment the thickening agent must have been swollen but must not have been disintegrated completely. Furthermore, high requirements are set for the texture, consistency and shelf life of the dairy product. We have found that an extremely satisfactory thickening agent for the continuous production of viscous dairy products can be obtained by treating cold water-insoluble material, precipitated from solution and containing at least 90% of amylopectin, or such material after treatment with a monofunctional esterifying or etherifying reagent, with a polyfunction reagent capable of cross-linking amylopectin, and reducing the particle size of the material so obtained. Our application No. 17537/68 (Serial No. 1,218,255) filed on even date herewith describes the preparation of such material.

A process according to the invention for the preparation of viscous dairy products comprises heating the ingredients of the product, including a thickening agent, at a temperature of 110 to 150°C, the thickening agent being an amylopectin derivative obtained as described above. The heating at the specified temperature ensures that the thickening agent in the product obtained is in the gelatinised state.

Where the cold water-insoluble material is treated directly with the polyfunctional reagent it is preferred that simultaneous or subsequent treatment with a monofunctional reagent e.g. vinyl acetate should also be carried out.

The cold water-insoluble amylopectin can be obtained by the Applicants' fractionating process (U.S. Patents Nos. 2,829,987; 2,829,988; 2,829,989; 2,829,990 and 2,822,305), in which starch is fractionated into amylopectin consisting of branched molecules and into amylose consisting of linear molecules. The amylopectin may be obtained by precipitation from a solution rich in amylopectin, the amylopectin remaining after amylose has been precipitated from a starch solution and has been removed from the solution.

Precipitated amylopectin has a structure which differs considerably from the structure of natural starch granules applied in general as a starting material for the treatment with polyfunctional reagents. Surprisingly, we have found, however, that precipitated amylopectin can successfully be treated with polyfunctional reagents whereby cross-links are formed between adjacent molecules. As a result of this cross-linking of the molecules the material shows less tendency to disintegrate. Furthermore, it has been found that the particle size of the resulting material can readily be reduced by grinding. So, in this way a cold water insoluble starch derivative can be obtained having a desirable average particle size.

This particle size determines also the texture of the products in which the starch derivatives are included. By choosing a suitable particle size the highly desirable pasty, smooth texture can be obtained. In the application of natural starch granules as a starting material for the cross-linking reaction a cross-linked product is obtained of which the particle size cannot be changed. It is hardly feasible to grind these granules.

Application of the amylopectin derivatives as a thickening agent in the continuous preparation of viscous dairy produce presents great advantages since, by cross-linking the molecules more or less, the gelatinisation behaviour of the thickening agent can be

influenced and, consequently, can be adapted to the production conditions applied.

Furthermore, by variation in the grinding process it is possible in a simple way to obtain a thickening agent having a particle size favourable for the texture, consistency and appearance of the final product. In this way products can be obtained having the desired smooth, pasty structure.

A very great advantage of the use of the derivatives is that these derivatives consist substantially of amylopectin, and a result of this is that products in which the derivatives are included are more stable in viscosity and can be kept during a longer period of time.

Consequently, use of the amylopectin derivatives enables diary products, which have shelf lives, texture, consistency, appearance and taste meeting the highest requirements, to be made.

The amylopectin derivatives which can be applied according to the invention as a thickening agent in the continuous production of viscous dairy products can be produced by treating an aqueous suspension of precipitated amylopectin with a polyfunctional reagent and grinding the cross-linked product, before or after a drying process to a desirable average particle size. The reaction with the polyfunctional reagent can, if desired, alternatively be carried out in an organic solvent or in dry state. Naturally only those polyfunctional reagents which provide derivatives which are not injurious to health can be used. These include epichlorohydrin, phosphorus oxychloride and sodium trimetaphosphate. Other suitable compounds are mentioned in the "Code of Federal Regulations" of the "Food and Drug Administration (F.D.A.)" of the U.S.A. The cross-linking degree desirable for the amylopectin derivatives, used according to the invention is determined inta alia, by the conditions under which the viscous dairy products are to be prepared and is in particular dependent on the process-times, temperatures and apparatus used.

The viscosity, of the derivatives will, after gelatinisation under conditions like those in the continuous production of the dairy products and after cooling to 20°C and at a solids concentration of 5,5%, usually be between 1000 and 10,000 cps. measured with a Brookfield viscosimeter (R.P.H. 6, spindle 3).

The amount of amylopectin derivative to be used as a thickening agent for the continuous production of the viscous dairy products is usually 40—55 kg. per 1000 l. of milk depending on the consistency desired. For the production of viscous dairy products which must have a long shelf life as regards stability in viscosity and texture, amylopectin derivatives can be used, which, besides the treatment with a polyfunctional reagent, have also been treated with a monofunctional esterifying or etherifying reagent, e.g. vinyl acetate. The products in which these amylopectin derivatives are included keep their viscosity and texture for a very long time.

EXAMPLE 1

In apparatus using direct steam heating, custard and pudding were prepared continuously, using the following recipes:

	Custard	Pudding
Milk	1000 l	1000 l
Sugar	70 kg	70 kg
Dextrose	25 kg	25 kg
Vanilla extract	140 ml	140 ml
Vanilla colouring substance	50 g	50 g
Thickening agent	55 kg	48 kg
Gelling agent		3 kg

The thickening agent consisted of a cold water-insoluble, cross-linked and ground amylopectin product. It was obtained by treating an aqueous suspension of flocculous amylopectin with phosphorus oxychloride so as to give a cross-linked product having a phosphorus content of 0.1%, and filtering the cross-linked product, intensively washing it with water, drying it and finally reducing its particle size, by grinding, so that 90% of the product had a particle size smaller than 75 microns. The amylopectin derivative had, after gelatinisation at 140°C, a viscosity in water at 20°C and at a solids concentration of 5.5%, of 4500 cps measured with a Brookfield viscosimeter (R.P.M. 6, spindle 3).

The gelling agent consisted of a combination of carageenate and locust beam gum. The aforementioned powdery components were added at 20°C with stirring to the milk. By means of heat exchangers the temperature of the mass was raised in two steps to 80°C, at a residence time of 1 minute. Then the mass flowed to a space into which steam was injected directly, whereby the temperature of the mass rose to 140°C. The residence time of the mass in this space amounted to 3 seconds. Thereupon the mass flowed to an expansion evaporator which was connected to a vacuum pump. In this expansion evaporator the superfluous condensed water was sucked off in the form of water vapour, by which the temperature of the mass fell to 70°C.

The custard-like product was aseptically put into bottles and had obtained a smooth-paste-like structure after one day's cool storing.

The pudding-like product was aseptically packed at 60°C and had obtained the desired consistency after one day's cool storing. The dairy products were still fully suitable for consumption after one month's cool storing, and during this time no separation of moisture had taken place.

EXAMPLE 2

In apparatus using indirect heating, custard and puddings were continuously prepared, using the following recipes:

	Custard	Pudding
Milk	1000 l	1000 l
Sugar	90 kg	120 kg
Dextrose	30 kg	
Thickening agent	53kg	43 kg
Cocoa	25 kg	25 kg
Gelling agent		3 kg.

The thickening agent consisted of a cold water-insoluble, cross-linked and ground amylopectin product. It was obtained by treating an aqueous suspension of flocculous amylopectin with phosphorus oxychloride so as to give a cross-linked product with a phosphorus content of 0.04%, filtering the cross-linked product, intensively washing it with water, grinding it such that 90% of the product had a particle size smaller than 75 microns and finally drying it. The amylopectin derivative had, after gelatinisation at 140°C, at 20°C and a solids concentration of 5.5%, a viscosity of 5500 cps measured with a Brookfield viscosimeter (R.P.M. 6, spindle 3).

The gelling agent consisted of a combination of carageenate and locust bean gum. The above-mentioned powdery components were added at 7°C under stirring to low pasteurized, highly homogenized milk.

The resulting mass was passed through the apparatus by means of a plunger pump. By two heat exchangers the temperature was raised from 7° to 97°C in two minutes. Then the mass was further heated by means of heating tubes, whereby the temperature of the mass rose to 140°C in 15 seconds. Thereupon the mass flowed through a cooler, whereby the temperature of the mass fell to 62°C. The still thin liquid custard and pudding products were finally aseptically packed. After one day's storing in a refrigerator the products had obtained the desired consistency. The dairy produce were still fully suitable for consumption after one month's cool storing, while during this time no separation of moisture had taken place.

EXAMPLE 3

By means of the same apparatus and using the same production conditions as in Example 1, custard and pudding were continuously prepared. The recipes used were the same as in Example 1 except that in this case an amylopectin derivative obtained in the following way was used as the thickening agent. An aqueous suspension of flocculous amylopectin was treated with sodium trimetaphosphate to give a cross-linked product having a phosphorus content of 0.1%. Subsequently the suspension was treated with vinylacetate such that the amylopectin was esterified to a degree of substitution of 0,07. Thereupon the cross-linked esterified product was filtered, intensively washed with water, dried and so ground that 90% of the product had a particle size smaller than 75 microns. The amylopectin derivative, after gelatinisation at 140°C, had, at 20°C and at a solids concentration of 5.5%, a viscosity of 5100 cps measured with a Brookfield viscosimeter.

The viscous dairy products prepared by means of the above-described thickening agent can be stored during a very long time without the structure of the viscosity being adversely affected.

WHAT WE CLAIM IS:—

1. A continuous process for the preparation of foods comprising milk and a starch-type thickening agent comprising heating the ingredients of the food, including a thickening agent, at a temperature of 110 to 150°C, the thickening agent being one obtained by a process comprising treating cold water-insoluble material, precipitated from solution and having an amylopect content of at least 90%, or such material after treatment with a monofunctional esterifying or etherifying reagent with a polyfunctional reagent capable of causing cross-linking of amylopectin and reducing the particle size of the derivative so obtained.

2. A process according to claim 1 wherein the thickening agent has been obtained by a process comprising treating the cold water-insoluble material with the polyfunctional reagent and simultaneous or subsequent treatment with a monofunctional etherifying and esterifying reagent.

3. A process according to claim 1 substantially as described herein with reference to any one of the Examples.

4. A viscous dairy product prepared by a process according to any preceding claim.

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